Course Syllabus

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CHEM 420/520 - Classical and Statistical Thermodynamics

Spring 2020

Instructor: Dr. Cecilia Clementi

Tuesday/Thursday 9:25am-10:40am

BRC 285

Office hours: by appointment

General Information:

The course starts with a brief review of classical thermodynamics, then the basic theory and formalism of statistical mechanics are introduced. Examples and applications are discussed. Students are encouraged to suggest topics they would like to see discussed in class (for instance an application of statistical mechanics into a particular research problem).

Pre-requisites:

Calculus, Undergraduate classical mechanics, Undergraduate thermodynamics

Textbooks:

Most of the material will be from the following books:

- Heat and Thermodynamics by Mark W. Zemansky, Richard H. Dittman (McGraw-Hill).
- Statistical Mechanics by Donald A. McQuarrie (University Science Books).
- Statistical Mechanics by R. K. Pathria (Elsevier).

Course Requirements:

Your final grade will be based on the following work:

- Weekly homework assignments (30 %)
- Two take-home midterm tests (35 % each)

Grading:

I use an absolute scale (no curving). The table below summarizes my grading scale.

>90%	A-/A/A+
80%-90%	B-/B/B+
70%-80%	C-/C/C+
60%-70%	D-/D/D+
<60%	F

Special Needs:

Any student with a documented disability needing academic adjustments or accommodations is requested to speak with me during the first two weeks of class. All discussions will be confidential. Students with disabilities should also contact Disability Support Services in the Ley Student Center.

Course Summary:

Date	Details	
Tue Jan 14, 2020	**Introduction, Temperature, 0th law of Thermodynamics, Work, PV diagram** (https://canvas.rice.edu/calendar?event_id=41822&include_contexts=course_28163)	12am
Thu Jan 16, 2020	**Work and Heat, First Law of Thermodynamics, Ideal Gas, Carnot Cycle** (https://canvas.rice.edu/calendar?event_id=41823&include_contexts=course_28163)	12am

Date	Details	
Tue Jan 21, 2020	Second Law of Thermodynamics, Entropy changes for reversible and irreversible processes (https://canvas.rice.edu/calendar?event_id=41824&include_contexts=course_28163)	12am
Thu Jan 23, 2020	Enthalpy, Helmholtz Free Energy, Gibbs Free Energy, Thermodynamic criterion for equilibrium, Maxwell's relations (https://canvas.rice.edu/calendar?event_id=41825&include_contexts=course_28163)	12am
Tue Jan 28, 2020	NO CLASS (https://canvas.rice.edu/calendar?event_id=42335&include_contexts=course_28163)	12am
Thu Jan 30, 2020	Chemical potential, Stat Mech: connecting microscopic picture to macroscopic averages, Statistical Ensemble (https://canvas.rice.edu/calendar?event_id=41826&include_contexts=course_28163)	12am
Tue Feb 4, 2020	Ensemble average and fluctuations, Random walk (https://canvas.rice.edu/calendar?event_id=41827&include_contexts=course_28163)	12am
Thu Feb 6, 2020	NO CLASS (https://canvas.rice.edu/calendar?event_id=42336&include_contexts=course_28163)	12am
Tue Feb 11, 2020	Microcanonical ensemble, Postulate of equal a priori probability, Probability and Irreversibility, The microscopic idea of entropy: Boltzmann's definition (https://canvas.rice.edu/calendar?event_id=41828&include_contexts=course_28163)	12am
Thu Feb 13, 2020	SPRING RECESS (https://canvas.rice.edu/calendar?event_id=41831&include_contexts=course_28163)	12am
Tue Feb 18, 2020	Entropy and equilibrium, Exchange between two systems, Temperature and thermal equilibrium, Second law of thermo from microscopic formulation (https://canvas.rice.edu/calendar?event_id=41829&include_contexts=course_28163)	12am
Thu Feb 20, 2020	Chemical potential and chemical equilibrium, Pressure and mechanical equilibrium, Canonical ensemble, Partition Function (https://canvas.rice.edu/calendar?event_id=41832&include_contexts=course_28163)	12am

Date	Details	
Tue Feb 25, 2020	MIDTERM 1 (https://canvas.rice.edu/calendar?event_id=41853&include_contexts=course_28163)	12am
	Thermodynamics in the canonical ensemble, Equivalence of statistical ensembles, Entropy and information (https://canvas.rice.edu/calendar?event_id=41833&include_contexts=course_28163)	12am
Thu Feb 27, 2020	Gibbs Paradox, Entropy for indistinguishable particles, Boltzmann statistics (https://canvas.rice.edu/calendar?event_id=41834&include_contexts=course_28163)	12am
Tue Mar 3, 2020	NO CLASS (https://canvas.rice.edu/calendar?event_id=42334&include_contexts=course_28163)	12am
Thu Mar 5, 2020	NO CLASS (https://canvas.rice.edu/calendar?event_id=42333&include_contexts=course_28163)	12am
Tue Mar 10, 2020	Grand Canonical ensemble (https://canvas.rice.edu/calendar?event_id=41835&include_contexts=course_28163)	12am
Thu Mar 12, 2020	Indistinguishability for bosons and fermions, Bose-Einstein statistics, Fermi-Dirac statistics (https://canvas.rice.edu/calendar?event_id=41836&include_contexts=course_28163)	12am
Tue Mar 17, 2020	SPRING BREAK (https://canvas.rice.edu/calendar?event_id=41842&include_contexts=course_28163)	12am
Thu Mar 19, 2020	SPRING BREAK (https://canvas.rice.edu/calendar?event_id=41843&include_contexts=course_28163)	12am
Tue Mar 24, 2020	Bose-Einstein statistics, Ferm-Dirac statistics (https://canvas.rice.edu/calendar?event_id=41837&include_contexts=course_28163)	12am
Thu Mar 26, 2020	Bose-Einstein condensation, Fermi gas (https://canvas.rice.edu/calendar?event_id=41838&include_contexts=course_28163)	12am
Tue Mar 31, 2020	Ideal gas, Partition function of monoatomic gas, Diatomic and polyatomic ideal gas, Equilibrium constant of ideal gas reactions (https://canvas.rice.edu/calendar?event_id=41839&include_contexts=course_28163)	12am

Date	Details	
Thu Apr 2, 2020	Ideal gas, Partition function of monoatomic gas, Diatomic and polyatomic ideal gas, Equilibrium constant of ideal gas reactions (https://canvas.rice.edu/calendar?event_id=41840&include_contexts=course_28163)	12am
Tue Apr 7, 2020	Application: model of Hemoglobin oxygen transport by using a grand canonical formulation (https://canvas.rice.edu/calendar?event_id=41841&include_contexts=course_28163)	12am
Thu Apr 9, 2020	Thermodynamic Perturbation Theory (https://canvas.rice.edu/calendar?event_id=41844&include_contexts=course_28163)	12am
Tue Apr 14, 2020	Cluster Expansion: basic theory and applications (https://canvas.rice.edu/calendar?event_id=41846&include_contexts=course_28163)	12am
Thu Apr 16, 2020	Critical Phenomena and Phase Transitions (https://canvas.rice.edu/calendar?event_id=41847&include_contexts=course_28163)	12am
	MIDTERM 2 (https://canvas.rice.edu/calendar?event_id=41854&include_contexts=course_28163)	12am
Tue Apr 21, 2020	Critical Phenomena and Phase Transitions (https://canvas.rice.edu/calendar?event_id=41848&include_contexts=course_28163)	12am
Thu Apr 23, 2020	Non-equilibrium thermodynamics (https://canvas.rice.edu/calendar?event_id=41850&include_contexts=course_28163)	12am